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THE IMPACT ON LAND VALUES OF TAXING BUILDINGS

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The conventional wisdom concerning the shifting of property taxes has it that taxes on land values or ground rents are borne by the owner of the land and are capitalized in the value of the land, while taxes on improvements are shifted forward to the tenants. There remains the possibility, however, that the impact of the tax on improvements may be felt in one way or another by the landlord, through changes in the overall demand. The supply of land, indeed, may be highly inelastic and not susceptible to substantial influence by taxation. The demand for land, however, may be so influenced, and if it is, the impact may be of significance. The present paper is an attempt to explore these relationships more fully with the aid of a somewhat drastically simplified mathematical model.

Suppose that the annual cost for financing and maintenance for a structure of mean height h is given by

$$(1) \quad C = (1 + x)f(h) = (1 + x)bh^a,$$

where the structure occupies a unit area of land, h is the ratio of standardized rentable space to land area, b and a are constants, with $a > 1.0$, and x is the effective rate of tax on the improvements. The city is built up in a circularly symmetrical pattern around a center, and prospective tenants all have a uniform pattern of a given amount of travel to or from the center per unit of rental space occupied. Preference for a central location is entirely accounted for by this transportation cost, so that the rental at a distance r from the center can be set equal to $t(R - r)$, where t is the cost over a unit distance of the amount of transportation with the center associated with the occupancy of one unit or rental area, and R is the radius of the built-up portion of the city, space being available beyond the radius R at zero rent. The height of construction at any distance r from the center is then, in equilibrium, given by equating the marginal cost of added space through increasing height with the value at which the space can be rented, or

$$(2) \quad \frac{dC}{dh} = ab(1 + x)h^{a-1} = t(R - r).$$

Solving for h , putting $B = b(1 + x)$, $q = R - r$, $k_1 = (t/a)^c$, $c = 1/(a - 1)$, we have

$$(3) \quad h = k_1 B^{-c} q^c$$

The total space available within the outer radius R is then

$$(4) \quad S = \int_0^R 2\pi r h \, dr = B^{-c} 2\pi k_1 \int_0^R (R - q) q^c \, dq = k_2 B^{-c} R^{c+2},$$

where $k_2 = 2\pi k_1 [1/(c + 1) - 1/(c + 2)]$.

The total cost of occupying space is uniformly tR , this being the rent at the center where there is no transportation cost, and the transportation cost at the rim where there is no rent. We can then suppose that the demand for space is given by

$$(5) \quad S = A t R^{-e},$$

where e is thus the elasticity of demand. Initially at least, we assume that all persons are uniform in their relative need for transportation to the center, and that their degree of preference for a central location is also uniform, so that at the equilibrium prices each person is indifferent, given the rents, as to where he locates.

Putting (4) and (5) together, we have $k_2 B^{-c} R^{c+2} = A t^{-e} R^{-e}$, which gives

$$(6) \quad R^{c+2+e} = (A/k_2) t^{-e} B^c \quad \text{or} \quad R = k_3 B^{c/(c+2+e)}$$

where $k_3 = (A/k_2) t^{-e} B^c$.

Thus in this model, as the tax rate on improvements, x , increases, and thus $B = b(1 + x)$ also increases, so does R . Taxes on improvements are thus a factor tending to increase urban sprawl, leading to increased ground rents near the perimeter.

The impact may be considerably different near the center, however. Ground rents at a distance r from the center are given by

$$(7) \quad g(r) = h \frac{dC}{dh} - C = aBh^a - Bh^a = (a - 1)Bh^a = (a - 1)C.$$

Thus by virtue of the cost function selected, ground rents are a fixed proportion of total rent and bear a constant proportion to improvement costs. This is in conformity with the frequent practice of appraisers of expecting a "normal" relation between the value of land and improvements to be fairly constant. Using (3) in (7), we have

$$(8) \quad g = (a - 1)B[k_1 B^{-c} q^c]^a = k_4 B^{-c} q^{c+1}$$

where $k_4 = (a - 1)k_1^a$, since $ac = c + 1$. At the center, $q = R = k_3 B^{c/(c+2+e)}$, from (6), so that

$$(9) \quad g(0) = k_5 B^{-c(e+1)/(c+2+e)},$$

and increasing the tax on improvements will lower the ground rent at the center.

The total ground rent is given by $G = \int_0^R 2\pi r g \, dr$, or

$$(10) \quad G = \int^R 2\pi k_4 B^{-e} (R - q) q^{e+1} \, dq = k_6 B^{-e} R^{e+3} \\ = k_7 B^{e(1-e)/(e+2+e)},$$

The effect of tax change on total ground rent thus depends on the elasticity of demand for urban space, in this model: an elastic demand results in an increase in total ground rents with decreasing improvement tax rates, and vice versa. Indeed, in this model, ground rents, structure costs, and transportation costs make up the total cost of space occupancy in constant proportions, and ground rents are in effect varying in proportion to the total expenditure on space.

One interesting possibility suggested by this model is that if the demand for space is sufficiently elastic, it would be possible to reduce or eliminate the tax on improvements and recoup the revenue out of the increase in ground rents or land values. The difficulty would be that this could not be done by a uniform tax on ground rents or land values, since land values near the periphery would go down rather than up, so that a uniform increment in the land tax would leave some property owners worse off. Only some form of tax on value increments, coupled with a compensation for those whose property values declined, could produce a situation where everyone was made better off.

Another suggestion presented by this model is that if a shift is made from taxes on improvements to taxes on land, land values in the center will rise relatively to those in the suburbs, and indeed values in the suburbs may decline.

Even these notions are based on what is an extremely oversimplified model. In reality the assumption of a constant elasticity of cost with respect to height or density of coverage is probably not fully realized, although I would hesitate to say at this point in which direction reality diverges or what effect this would have on the model. Another and more one-sided assumption is that all users of space have uniform space-transportation ratios, whereas actually there will be a concentration at the center of those who for one reason or another, find separation from the center more expensive.

Still another factor that calls for consideration is that demand for space near the center tends to be in some degree autocatalytic: the demand for space is enhanced by the concentration of space near the center.

Representation of these complications even in the simplest possible form leads to a much more complex model about which it is difficult to say anything very precise without more analysis than there has as yet been time for. All that is clear at the moment is that the classical assumption that the incidence of the tax on improvements is on the

tenant and that land values are affected only by the capitalization of the land tax need to be considerably modified if a reasonably complete analysis is made, and that the issue of land taxation versus the taxation of improvements may have fairly substantial repercussions on the relative finances of the core city as compared with the suburbs.

CHAIRMAN GAFFNEY: Thank you very much. One of the many wonderful things about Bill is no matter how far he orbits he always re-enters and splashes down on something — relevant. (Laughter) That was intended as a compliment. (Laughter)

I was at a cocktail party last week. The hostess offered a drink to a lady guest who said, "Really I shouldn't. This is my second," to which the hostess replied, "no, dear, it is your third, but who's counting?" (Laughter)

Our third speaker, Professor Coleman Woodbury, is Professor of Urban and Regional Planning at the University of Wisconsin. That is the real University of Wisconsin and not the one I come from. Professor Woodbury has long experience in regional planning which is of course mixed up with the property tax which has caused him to become an authority in that field as well.

A recent chapter in his long experience is service on the National Commission on Urban Problems, the Douglas Commission. This Commission was very critical of some ongoing programs and no doubt there are those who would like to see its report drift down the long alleys of time into oblivion, but the National Tax Association Board of Directors is not among them. They indicated the liveliest interest in having a full report of the findings of this Commission and Professor Woodbury, a faithful and outstanding member of that Commission, will now do that for us. Coleman. (Applause)

NATIONAL COMMISSION ON URBAN PROBLEMS: PROPERTY TAX RECOMMENDATIONS

COLEMAN WOODBURY

Member of NCUP and the University of Wisconsin

Both because of the subject assigned me and because NCUP probably is, for various reasons, one of the less well-known commissions set up during the Johnson Administration to study major problem-areas in our national life and affairs, let me begin with a brief account of its origins, personnel, procedures, and output.